Ice Control Enterprises Inc.

40 FOREST AVE.
HAMILTON, ONTARIO
L8N 1X1
(416) 528-4283

T.P. 8432 E

PROJECT "FRIGONAV"

HOVERCRAFT TYPE 140 OPERATING EXPERIENCE

FEBRUARY - MARCH 1987

by D. Jones P. Eng.

Prepared for the Transport Development Centre

Transport Canada

Montreal

April 1987

(Ce rapport contient un sommaire en Français)

CA1
DTC 800
87
P62
c.2

C71
D7C200
S7
F
C.

The contents of this report reflect the views of the Contractor, and not necessarily the official views or policies of the Transport Development Centre, Transport Canada

368374

Transport Canada / Transports Canada

Development / Développement

REPORT DOCUMENTATION FORM

1. Transport Canada Report No.	2. TDC Project No.	3. Recipient's Catalogue No.
8432E	6862/63 - 6864/65	

4. Title and Subtitle	5. Report Date
Project "Frigonav" Hovercraft Type 140 Operating Experience February - March 1987	April 1987
	6. Performing Organization Report No.
7. Author(s)	8. Transport Canada File No.
D. Jones, P.Eng.	D 1460-247
9. Performing Organization Name and Address Ice Control Enterprises Inc. 40 Forest Ave. Hamilton, Ontario L8N 1X1	10. DSS File No. T 8200-6-6557
	11. DSS or Transport Canada Contract No. T 8200-6-6557/01-0LQ
12. Sponsoring Agency Name and Address Transportation Development Centre (TDC) 200 Dorchester Blvd. West Suite 601, West Tower Montreal, Quebec H2Z 1X4	13. Type of Report and Period Covered
	14. Sponsoring Agency Code 6862, 6863, 6864, 6865
15. Supplementary Notes Project co-sponsored by Ports Canada	16. TDC Project Officer J.E. Laframboise

17. Abstract

Project "Frigonav" involved extending the navigation season in the upper reaches of the Saguenay River by clearing ice from the channel with a 7 tonne hovercraft.

The program was successful and a considerable amount of data was obtained regarding all facets of operating this size of craft in a winter environment.

Special equipment to improve the icebreaking capability was not tested because no ice was encountered that could not be broken by the type 140 alone. However, an adaptor permitting easy use of an ice knife has been built.

This report presents the details of the operation, including the Daily Log.

18. Key Words	19. Distribution Statement
Air Cushion, Air Cushion Icebreaking, Hovercraft, Airtrek 140, Harbour, Grooving, Ice Grooving Knife.	Limited number of copies are available from the Transportation Development Centre.

20. Security Classification (of this report)	21. Security Classification (of this page)	22. No. of Pages	23. Price
Unclassified	Unclassified		

TDC CDT 79 005 Rev 86

Transports Canada / Transport Canada

Développement / Development

FORMULE DOCUMENTAIRE DU RAPPORT

1. N° du rapport Transports Canada	2. N° de l'étude — CDT	3. N° de catalogue du destinataire
8432E	6862/63 - 6864/65	

4. Titre et sous-titre	5. Date du rapport
Project "Frigonav" Hovercraft Type 140 Operating Experience February - March 1987	avril 1987
	6. N° du rapport de l'organisme exécutant D 1460-246/247
7. Auteur(s) D. Jones, P.Eng.	8. N° de dossier Transports Canada
9. Nom et adresse de l'organisme exécutant Ice Control Enterprises Inc. 40 Forest Ave. Hamilton, Ontario L8N 1X1	10. N° de dossier — ASC T 8200-6-6557
	11. N° de contrat — ASC ou Transports Canada T8200-6-6557/01-0LQ
12. Nom et adresse de l'organisme parrain Centre de développement des transports (CDT) 200 ouest, boul. Dorchester Suite 601, tour ouest Montréal, Québec H2Z 1X4	13. Genre de rapport et période visée
	14. Code de l'organisme parrain 6862, 6863, 6864, 6865
15. Remarques additionnelles Projet co-parrainé par Ports Canada	16. Agent de projet — CDT J.E. Laframboise

17. Résume

Le projet Frigonav visait à prolonger la saison de navigation dans le Saguenay en déglaçant un chenal dans son cours supérieur, au moyen d'un aéroglisseur de 7 tonnes.

Le programme a pleinement réussi et une grande quantité de données a été assemblée concernant tous les aspects de l'exploitation d'un engin de cette taille dans un climat aussi rigoureux.

L'équipement spécialisé destiné à améliorer les performances en déglaçage n'a pas été utilisé vu que l'engin n'a pas rencontré de glaces trop épaisses pour lui. Cependant un adapteur permettant l'utilisation aisée d'un couteau à glace a été construit.

Le présent rapport décrit l'ensemble de cette opération, grâce notamment au contenu du carnet de bord.

18. Mots-clés	19. Diffusion
Coussin d'air, déglaçage par aéroglisseur, Airtrek 140, aéroglisseur, ports, rainurage, couteau à glace.	Le Centre de développement des transports dispose d'un nombre limité d'exemplaires.

20. Classification de sécurité (de ce rapport)	21. Classification de sécurité (de cette page)	22. Nombre de pages	23. Prix
non-classifié	non classifiée		

CDT TDC 79-005 Rev 86

Acknowledgements

The author wishes to acknowledge the valuable assistance of Mr.J.E.Laframboise, Transport Canada, Mr G.Desgagnes & Mr.R.Dufour of Ports Canada, Chicoutimi. & the rescue personnel from Canadian Armed Forces base Baggotville.

The technical advise from Mr.D.L'Heureux of the Canadian Coast Guard was also greatly appreciated.

Summary

The area around Chicoutimi is supplied with fuel from the storage tanks normally filled by ships docking at the oil pier at Pointe d'Islet.

The Saguenay River freezes in winter and the channel is too shallow for the Coast Guard ice breaker to clear a passage between the oil pier and the deep water at Grande Anse, 15km downstream. This limits the navigation season to the times when there is no ice in this area, and results in any winter re supply being carried out by truck. This alternative is more costly, especially when the half load season is in force on the roads.

Project "Frigonav" was instagated by Ports Canada, Chicoutimi, to evaluate the possibility of clearing the channel between the oil pier and Grande Anse by hovercraft, thereby extending the navigation season and eliminating the need to move fuel by road.

The principle of ice breaking with a hovercraft had been demonstrated by the Coast Guard with the 50 tonne "Voyaguer". Unfortunately this vehicle had a full winter program and would in any case be too large and expensive to operate in this location.

The Canadian designed and built Airtrek 140, owned by Ice Control Enterprises Inc, and operated by Jones, Kirwan and Associates Ltd, was chosen as the more suitable machine. It is 11.2 m long by 5.7 m wide and has a gross weight of 7 tonnes.

The craft arrived at Chicoutimi in early February and was stationed on the ice in front of the Port Canada Office. This location confirmed the design claim that the machine could be maintained and serviced in the open, providing there was a source of electricity. Some initial problems were encountered with the craft systems resulting from the extreme cold and contaminated fuel.

The first trials involved marking the route between the base at Chicoutimi and Pointe d'Islet, and the channel down to the open water upstream of Grande Anse. At the end of this period the engine failed due to contaminated fuel and the craft froze in the ice. It was lifted to shore by a C.A.F. helicopter.

The ice thickness ranged from 30 cm in the channel to 70 cm in front of the pier. A 300 m wide path, 1.5 km long. was cleared in the thick ice in 3 hours.

Prior to these tests it was assumed that the 140 could break up to 40 cm thick. The fact that a greater value was fractured should not be considered as an increase in the basic performance, since the results may be influenced by the condition of the ice and the 13 cm of slush on top of it.

More operational data may be required before companies schedule their ships during this period on a regular basis. It is proposed that any future program should use a modified 140, with additional power and ice impact protection.

An ice grooving tool was manufactured to assist in breaking ice if the 140 encountered an area that could not be broken by the craft alone. This never occurred, and the performance of the sled was not verified.

SOMMAIRE

L'approvisionnement en combustibles de la ville de Chicoutimi et de sa région se fait en été par des bateaux-citernes alimentant des réservoirs situés a Pointe d'Islet.

En hiver, lorsque le Saguenay gèle, le chenal maritime est trop peu profond pour permettre le passage d'un brise-glace chargé d'ouvrir un chemin entre le terminal pétrolier et Grande Anse, 15 km en aval, où l'eau redevient profonde. Il en résulte donc une saison de navigation maritime écourtée et la nécessité d'assurer l'approvisionnement par la route. Solution plus coûteuse, surtout lorsque la réglementation sur le transport routier durant le dégel entre en vigueur.

Lancé à la demande de Ports Canada à Chicoutimi, le projet "Frigonav" visait à étudier la faisabilité de déglacer le chenal entre le terminal pétrolier et Grande Anse au moyen d'un aéroglisseur, prolongeant ainsi la saison de navigation maritime et mettant un terme à l'approvisionnement par la route.

La faisabilité du déglaçage à l'aide d'un aéroglisseur a déjà été établie grâce au Voyageur, engin de 50 tonnes appartenant à la Garde côtière; mais, en plus d'être déjà pleinement engagé ailleurs, il était de toute façon trop gros et trop coûteux pour l'utilisation envisagée.

A sa place, les responsables ont choisi l'Airtrek 140, un aéroglisseur de conception et de fabrication canadiennes, long de 11,2 m et large de 5,7 m, avec un tonnage brut de 7 tonnes; propriété de Ice Control Enterprises Inc. et exploité par Jones, Kirwan and Associates Ltd., il était mieux adapté pour ce travail.

Arrivé à Chicoutimi au début de février, l'engin a été parqué sur la glace, face au bureau de Ports Canada, dans le but de vérifier la prétention des concepteurs voulant que son entretien courant et sa maintenance pouvaient se faire à l'extérieur, à condition d'avoir accès à une alimentation en électricité. Au début, l'engin a souffert en raison du grand froid et du carburant contaminé.

Les premiers travaux ont consisté à baliser le tracé entre le terminal pétrolier et Pointe d'Islet, ainsi que le chenal jusqu'à la Grande Anse. C'est là que l'engin a été pris dans la glace à cause d'une panne de moteur due au carburant contaminé. Il a donc fallu le dégager au moyen d'une tronçonneuse et le ramener à terre par un hélicoptère de l'aviation canadienne.

La glace avait entre 30 cm d'épaisseur dans le chenal et 70 cm devant le terminal. En trois heures, l'engin a pu ouvrir un chemin de 300 m de large et 1,5 km de long dans la glace la moins épaisse, mais il a dû faire plusieurs passages là où la glace était plus épaisse.

Avant cette opération, on croyait que la limite du Airtrek 140 était 40 cm d'épaisseur. Le fait qu'il ait pu fracturer des glaces plus épaisses ne signifie pas que ses performances de base se soient améliorées, le gain de performances pouvant avoir été attribuable à l'état de la glace et aux 13 cm de neige fondante l'a recouvrant.

Des essais plus poussés seront nécessaires avant que les armateurs puissent prévoir un service régulier d'approvisionnement en hiver. Il est suggéré que, pour l'avenir, on utilise un engin 140 modifié, plus puissant et mieux renforcé contre les glaces.

TABLE OF CONTENTS

		Page
1.0	Introduction	1
2.0	Hovercraft type 140	1
3.0	Area of Operation	2
3.1	Operating Base	3
4.0	Operational Data	3
5.0	Ice Breaking	4
6.0	Inspection of the 140	8
7.0	Test with the sled	9
8.0	Conclusion	10
9.0	Proposed Modifications to Type 140	11
FIG 1		12
FIG 2		13
FIG 3		14
FIG 4		14

APPENDIX "A" - Daily Log

1.0 Introduction

The area around Chicoutimi is supplied with fuel from the storage tanks normally filled by ships docking at the oil pier at Point d'Islet.

Ice in the channel between Pointe d'Islet and the furthest point that can be reached by the Coast Guard ice breaker at Grande Anse limits the navigation period, and results in any winter re supply being carried out by truck. This is an expensive alternative, especially when the half load limit has been imposed on road transportation.

Project "Frigonav" was instigated by Ports Canada to determine if a medium size hovercraft could open the channel earlier, hopefully at the time the ice breaker arrived at Grande Anse.

The project centred around the Airtrek 140 with the objective of the program not only to evaluate the ice breaking performance, but to gain experience of operating such a vehicle. The results would be used to decide whether both the concept and craft were viable.

This report presents the data for the period of the program which started in early February and finished at the end of March. The Daily Log is attached as an Appendix.

2.0 Hovercraft type 140

The type 140 is a Canadian designed and manufactured craft built to be serviced in the cold, away from a fixed base. An isometric view, together with the leading particulars,

is presented in Fig 1.

It is powered by a Caterpillar 3208 diesel engine which drives the propeller through a belt and sprocket assembly, and the lift fans by a hydrostatic system. The skirt arrangement consists of 96 individual segments that can be changed without the need to jack up the machine.

The vehicle is certified by the Canadian Coast Guard and has a maximum weight limit of 7,000 kg, and a wind speed of 25 km/hr.

The unit was weighed at the end of the program on the scales at the Grande Anse terminal as follows:

Truck + trailer + craft	15,440 kg
" " no "	8,610 kg
Weight of craft	6,830 kg

There was 930 kg of equipment still on board, which reduced the net weight to 5,900 kg, 700 kg above that recorded in Ottawa during the trials of January of 1986. The reason for the increase has not yet been identified, but cannot be due to ice since the temperature had been well above freezing for a number of days, and no ice was seen as it was being loaded onto the trailer.

The maximum operational weight for this program, assuming full fuel tanks, the sled, dinghy and a crew of two is 7,500 kg.

3.0 Area of Operation

The 140 was scheduled to clear the channel between bouy

S 32 and the turning basin in front of the pier Quai Maltais, by S 52. A chart of the location is presented in Fig 2.

3.1 Operating Base

Inspection of the area showed that there was an ice jam at S 32 that extended nearly across the river, and over which the 140 could not pass. Since the area of interest was upstream of S32, it precluded using the terminal at Grande Anse as a base.

A location under the oil pier was considered, however, the ice was very rough and refueling would have been difficult. The 75 cm thick ice in front of the wharf at Chicoutimi was finally selected, the location is presented in Fig 3.

4.0 Operational Data

Daily servicing, together with any repairs, was carried out on the ice without the need to bring the craft into a heated building. The details are described in the Daily Lot, presented as Appendix "A".

The initial problems were related to the cold weather of early February and were resolved when the hydraulic oil and the fuel were changed from winter to arctic grades. However, difficulties with contaminated fuel persisted throughout the tests and must be overcome before any new program takes place.

The low temperature did not affect the rest of the craft,

and there was no sign of the skirt material boarding.

During the tests only 14 skirts needed repairing, two were ripped and the others had the inner tags torn because the ice on the lanyards would not let them slip around the inner attachment tube and shear the pin which was designed to break under load.

The cold and fuel problems reduced the availability of the craft to 119 hrs, but these could not always be used because of high winds and an incoming tide. The operational hours were 57.4, with engine hours of 38.1. The difference between these two values results from the craft being shut down while measurements were taken and broken ice permitted to flow downstream.

The average fuel consumption was 53 lt/hr.

5.0 Ice Breaking

The program started on the 7th of February by breaking a piece of 30 cm ice from the edge of a small patch of water in front of the wharf.

By the 25th the cold weather and fuel problems had been resolved and the craft was driven down the six kilometres of frozen river to the vicinity of S 47. The surface in the center of the channel was reasonably flat with snow dunes 0.5 m high. Two pressure ridges, over one meter high, crossed the path but low spots were found in each through which the machine could pass.

The route was marked by flags of different colours, about 0.3 m square. Unfortunately they were difficult to see if there was no wind, or it was blowing directly towards, or away, from the craft. In future they should be replaced with barrels painted with "Dayglow" or a similar product.

Inspection of the ice over the area of interest showed three distinct thicknesses. The main channel between S 52 and S 45 was flat and was covered by a 45 cm sheet with 6 cm of loose snow on top. A one meter high pressure ridge ran parallel to the end of the pier and crossed the channel between S 45 and S 47. The thickness from the ridge to the pier was 71 cm. Downstream of this ridge the surface was flat and the ice 35 cm thick.

Up until February 27th the operation had been one of familiarization with the surroundings, and measuring the ice thickness at various locations. The details are recorded in the daily log. This first phase was considered to be complete, the 140 was driven to the open water, 0.5 km downstream of S 38, to break ice and see where the broken pieces went with respect to the jam at S 32.

As the edge of the ice was approached it was noticed that the tide was coming in and bringing with it large blocks of ice from the jam at S 32. Contact with this debris would have caused major structural damage so the machine went to a calm spot at the position of S 37. No difficulty was experienced in breaking the 30 cm thick ice, but since

the current would not let the pieces clear, it was decided to stop until the tide changed.

The next series of tests involved the sled cutting a groove in the ice to assist in ice breaking and hopefully make the ice break along a predetermined line. The sled was initially towed by the lifting cables attached to the rear lifting eyes, but in this configuration directional control was impossible and the craft always wound up heading downwind.

A different arrangement was tried in which a rope was attached to the left lifting eye, then passed through a pulley on the front of the sled to the right hand eye. This permitted the rudders to yaw the craft without being restrained by the drag of the sled. There was a marked improvement and the heading of the 140 could be controlled.

The open water was now half way between S 40 and S 45 but the action of the tide had caused a 60 cm high rough area in the middle of the previously flat sheet. There was considerable contact between the bottom of the craft and the surface over this section, to the point where the debris left on the ice indicated that much of the wooden skids had been torn off.

The vehicle would no longer accelerate through the point of maximum drag and a quick check of the underside revealed about 600 kg of ice had accumulated on the skirt lanyards and the structure. Ice had also built up on the deck such that the intake to the left lift fan was half closed. There

was heavy ice on the struts in the thrust duct and on the rudder leading edges. However, directional control had not been affected, probably due to the fact that the rudders were being continuously moved from full left to full right and back.

There was no ice on the propeller blades.

A technique was developed whereby the craft was accelerated on the ice up to the speed at which the greatest wave would occur and then entered the water just below the desired point of wave impact. Using this method a section of ice 200 m wide and 300 m long was broken in one hour, although much of the time was spent avoiding the peaks in the rough ice.

At this point the craft became unservicable for two weeks because of water in the engine fuel pump.

Ice breaking restarted on March 21st with the craft being driven down to the open water, 100 m downstream of S 45. A section, 0.5 km long by 0.3 km wide of 37 cm thick ice was broken in three hours, although some of the time was spent negotiating the center jam. The air temperature was well above freezing which stopped the craft icing but made the sheet very elastic and difficult to break.

Work continued on the 23rd and a channel 0.3 km wide was broken to within 100 m of S 52 in three hours, a distance of 1.5 km.

On the 24th much of the remaining ice between the pressure ridge and the pier was dislodged, although progress was slower because the thickness had increased to between 54 cm and 66 cm, under a cover of 15 cm of slush.

A small area of thick ice was broken the next day to clear the basin in front of the pier and complete the program. The craft was driven to Grande Anse and lifted out of the water.

6.0 Inspection of the 140

The hull started to flood while the craft was berthed at Grande Anse awaiting the arrival of the crane. A quick inspection of the bottom when it was being lifted out showed that there were no large holes in either the main beams or the floor pans. Flooding had resulted from a gash in the rear bulkhead which rapidly filled with water, which then gradually seeped into the engine bay through holes left unplugged when wires and pipes had been removed during the development period.

The lack of damage was surprising considering the impacts that had been felt when travelling over the rough sections of ice.

The propeller was undamaged except for some dents in the leading edge of the stainless steel sheath on each blade.

Wear was seen on the front and side segments, a typical

view from the front is presented in Fig 4. Whether this was due to contact with the surface or delamination in the cold is not known.

7.0 Tests with the sled

The grooving sled was carried on board at all times in case an area of ice was encountered that could not be broken by the craft alone.

Although no such incedent occurred, some tests with the knife were conducted, with particular reference to the ability to steer the hovercraft when towing the sled. The first configuration involved towing the sled by a cable attached to both the rear towing eyes on the deck. In this case the 140 would only travel in a straight line, and would not respond to the movement of the rudders.

A bridle was installed by running a rope through a pulley attached to the front of the sled and securing the ends to the towing eyes. The craft could now be steered, although it took ½ kilometer to turn 180^{o} in calm conditions.

The towing "A" frame was manufactured, and the modifications made to the bow and stern of the 140. This final configuration was not tested because the ice flushed out of the river before the installation had been completed.

8.0 Conclusion

The results of this part of the program have shown that a hovercraft the size and weight of the type 140 can extend the navigation season in the upper reaches of the Saguenay River. More date may be required before ships are scheduled during this period on a regular basis.

An ice breaking hovercraft must be able to accelerate quickly to reduce the time and manoeuvering distance; the 140 was not designed to meet this specification. The increase in weight, especially if equipment such as the sled is to be carried permanently, will affect the performance and make the present thrust marginal. However, if these limitations are understood, then more useful information can be obtained with the present craft.

Further trials may identify additional features that should be included in the optimum machine, and building a new vessel at this time may be premature.

The alternative would be to modify the 140 by changing it from a passenger vehicle to an ice breaker with increased power but a limited payload.

9.0 Proposed Modifications to Type 140

The lift fans would be driven from a second, low powered, diesel engine located in the cabin. Removing the present hydrostatic drive from the main engine would increase the power to the propeller and the available thrust.

The cabin would be converted into a work space also containing a new fuel tank and the rudder control system. A fire door would be cut in the rear bulkhead so that the whole area could be warmed by a space heater. Low temperature problems would be substantially overcome and maintenance could be carried out in the warm.

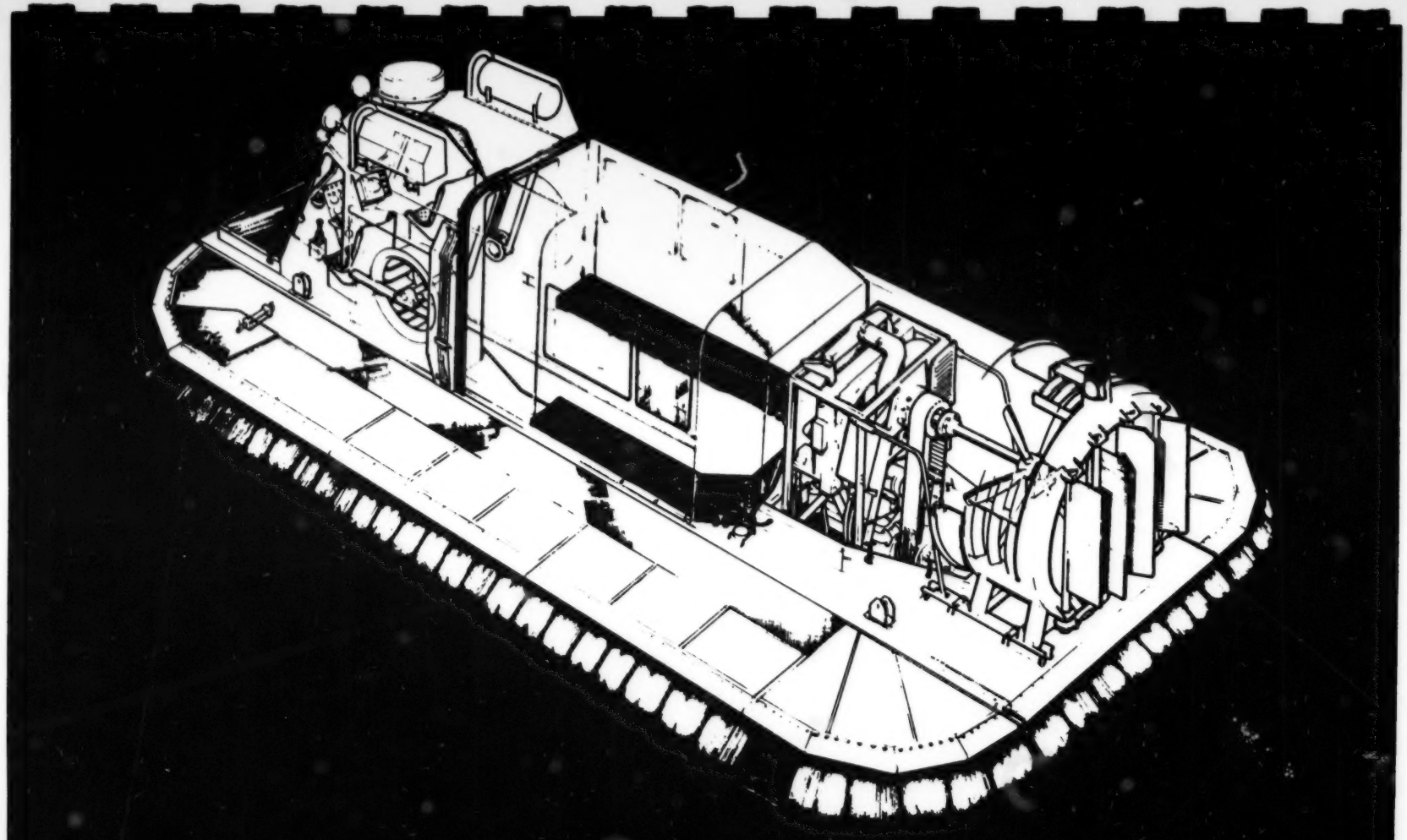
The bouyancy chambers would be filled with the foam pellets to eliminate the loss of bouyancy due to small punctures.

A protective shield would be placed under the hull to protect the main structure and stop the craft being hung up by the ice jammed in the hollows formed by the beams and the floor.

The bottom pins retaining the side sponsons in position would be replaced by "A" frames above the deck, thus avoiding

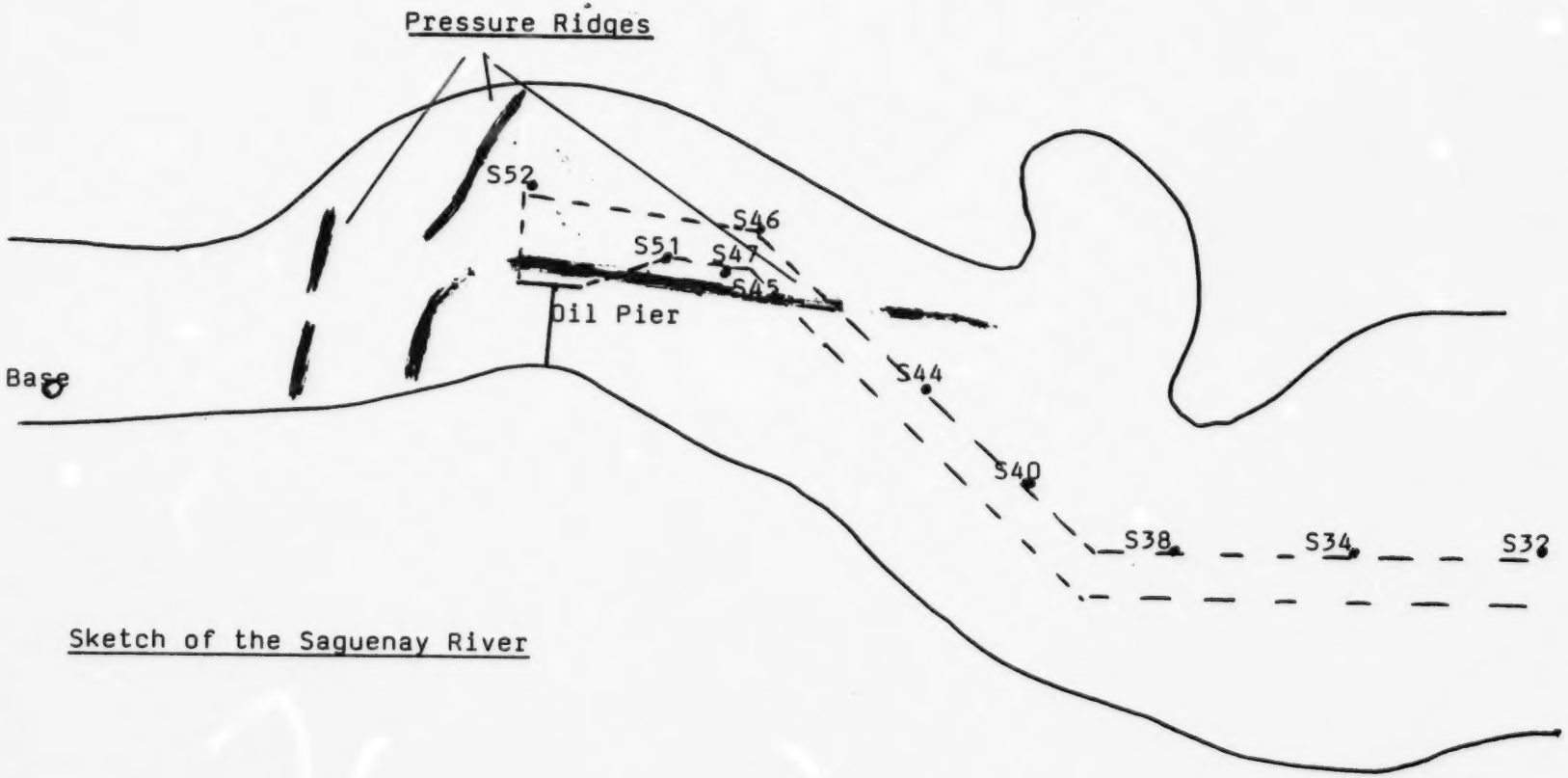
the problem caused by ice build up in this area which prevented the sponsons from being raised.

A cost estimate has not yet been prepared, but the modifications should not exceed $50,000.



Length	11.2 m	36.75 ft
Width	5.74 m	18.83 ft
Max Load	1,360 kg	3,000 lbs. (sixteen people)
Fuel Capacity	363 kg	800 lbs. (100 Imp. Gal.)
Crew of Two	145 kg	320 lbs. (pilot & radar nav.)
Craft Weight	4,832 kg	10,655 lbs.
Max All Up Weight	6,700 kg	14,775 lbs.
Fuel Consumption	45 kg/hr	100 lbs./hr. at max. cruise speed

Fuel Duration		8 hrs. at max. cruise speed	
Cruise Speed-Water		61 kph	38 mph
Cruise Speed-Ice		72 kph	45 mph
Cabin Size	Length	3.93 m	12.92 ft.
	Width	2.08 m	6.83 ft.
	Height	1.83 m	6.00 ft.
Freight Area		11.9 m^2	128.33 sq. ft.



Sketch of the Saguenay River

Fig 2

BASE AT CHICOUTIMI Fig 3

SKIRT WEAR Fig 4

APPENDIX "A"

Daily Log

Thursday, February 5th

Meeting of the Project Group. Drove to Grande Anse to check ice conditions upstream of S 32. There is some 3 km of open water close to the buoy, with an ice jam at the lower end, too high for the 140 to cross, which precludes using the terminal as a base.

An area on the ice in front of the wharf at Chicoutimi is chosen as the best site for the craft.

Friday, February 6th

Vehicle arrived at noon. The road from Quebec to Chicoutimi had been rough and caused the craft to move forward on the trailer, damaging the front left hand bottom bracket on the main hull. This was repaired before the sponson was lowered.

The 140 was unloaded and on the ice within half an hour of the crane arriving.

Saturday, February 7th

The craft had been left overnight on the ice close to the wharf and the weight of the craft, together with the tide, resulted in a pool of water forming under the hull, which was starting to freeze.

The engine started immediately but the cable to the hydraulic pump was frozen and a jury rig was installed so that the machine could be moved before it became frozen to the surface.

The vessel was taken to a patch of open water by the bridge to wash off the road dirt. A small section of 30 cm thick ice was broken from the edge.

Sunday, February 8th

Vehicle moved to stop freezing to the snow. The low engine oil pressure warning light came on, however, this was considered a false alert because the crankcase level was correct and the pressure gauge read 60 P.S.I.

The engine lost power, the fuel water separator was found to be full of ice, and the power returned when this had been cleaned out.

Monday, February 9th

Dinghy was installed on the right hand sponson. Checked the radio link with the office. Engine would not start due to low temperature.

Tuesday, February 10th

Engine would not start, requested Hydro so that engine could be heated externally. The ladder arrived to give direct access to the site over the front of the wharf. Decided to call Caterpillar to install a block heater in the engine.

Wednesday, February 11th

Too cold to work outside. Inspection of the craft by Mr. Wade, Flight Permit changed to exclude the need for a compass swing.

Thursday, February 12th

Block heater installed. Lost all the antifreeze because the discharge from the drain plug could not be collected in a can.

Friday, February 13th

Engine still would not start, problem now considered to be the viscosity of the hydraulic oil in the pump. Directed a space heater onto this area and the engine finally turned fast enough to start. It was allowed to warm up for 10 minutes at which time the lift system was engaged. There was an immediate discharge of oil into the cabin from the hydraulic motor, and a seal was suspected.

Started to remove the motor.

Saturday, February 14th

Removed the hydraulic motor and cleaned up the spill in the cabin.

Sunday, February 15th

Drove by road towards buoy S 32 to check on the size of the area of open water. Now about 1 km long, starting .5 km downstream of the S 36 position.

Monday, February 16th

Motor inspected by Chamionex, problem caused by too thick an oil holding the seal open. Changed oil to Arctic grade and reinstalled the motor.

Tuesday, February 17th

Engine started easily, changed from "carry on" cans to the main tanks.

Took ice thicknesses opposite the oil pier. It was 44 cm in the channel and 70 cm between the pressure ridge in front of the pier and the pier itself.

Wednesday, February 18th

Engine started easily but became rough after 15 minutes and would not run above 1,500 rpm. The water separator contained a substance which was drained and the power restored. This occurred several times and the fuel became suspect. Caterpillar said that it may be due to wax precipitating out of the fuel due to the cold temperatures.

Thursday, February 19th

Fuel was pumped from the craft tanks into barrels and replaced with Arctic grade. A detergent was put into the fuel to clean out the wax. Engine now operational.

Friday, February 20th

Crew on leave.

Tuesday, February 24th

Control system response poor because of air still in the piping after the change to the Arctic grade hydraulic oil.

Went down the river to S 47 to mark the route and take more ice thickness measurements. Engine lost power on the return journey due to a substance in the water separator. Removed the filter in this unit and power came back.

Smoke was seen coming from the area of the cross shaft in the cabin roof. Inspected installation, no bearings hot, suspected hydraulic motor shaft seal leaking and making a mist which had been mistaken for smoke.

Restarted engine, no more smoke appeared.

Wednesday, February 25th

Installed new water separator and engine fuel filter. Purged a considerable amount of air from the control lines and reset the control valve to position 7. The system has greatly improved although there is still a tendency to stick in full left.

Took Mr. L'Heureux of the Coast Guard on the craft and broke 50 cm of ice near the bridge.

Appear to have a broken front hinge on the left hand sponson.

Thursday, February 26th

Lifted the craft onto the wharf at 08.00 hrs, repaired the hinge, and put the 140 back on the ice by mid day.

Took Mr. J. Laframboise on the craft and broke 40 cm of ice near the bridge.

Controls still jamming full left.

Friday, February 27th

Placed the sled on the right hand sponson to balance the dinghy.

Went down the ice towards S 38, but had difficulty finding the previously marked route because the flags are too small. Crossed the 60 cm pressure ridge between S 45 and S 47 without any difficulty. The ice thickness at S 40 was 30 cm.

Went to the edge of the ice sheet half way between S 40 and S 38, the incoming tide had dislodged large blocks from the jam at S 32 and was carrying them along the open water at 6 km/h. Contact with these would have resulted in extensive km/h damage to the structure and a calm area was noticed 0.5 km downstream. The water was approached across the ice at about hump speed and a stern wave was set up in the 27 cm ice that caused considerable cracking. An area 100 m x 300 m was broken on the return journey. The current would

not permit the broken pieces to float away and further operations was postponed until the tide had changed.

Saturday, February 28th

Wind above limits, spent the day doing routine maintenance and some skirt repair.

Sunday, March 1st

Open stretch of water now 4 km long, extending 0.4 km upstream of S 40.

Only sufficient fuel for 3 hours of operation, not enough to go to the open water and break any reasonable quantity of ice. The current measuring device was therefore loaded onto the craft and the following measurements taken at S 52 where the ice thickness was 48 cm.

Data taken between 16:00 and 16:15

Speed cm / sec		70	87	85	85
Direction		240	240	240	240
Temperature 0°C		0	0	0	0
Depth	m	2.0	4.0	6.0	8.0

Monday, March 2nd

Wind above limits, carried out routine maintenance.

Tuesday, March 3rd

Went down the river to the open water, the tide was going out and had a current of abour 6 km/h, some

three times that km/h encountered on the Rideau River. The craft would not accelerate through hump due to ice in the engine bay causing a stern down attitude, requires more ballast in the nose.

Cut a straight 10 cm groove in the ice with the sled.

Part of the rudder control system failed at the weld, disconnected the right center rudder, placed the rest of the system in reverse and returned to base by steering the craft with ropes attached to the loose rudder and standing at the cabin door.

Wednesday, March 4th

Repaired broken control arm. Filled the front ballast with 140 kg of fuel and added a further 150 kg in concrete blocks, giving a slightly nose down attitude.

Went to the open water at an average speed of 44 km/h and placed flags along the route to indicate the edge of the shipping channel. Ice was broken at the edge of the sheet but would not clear because the tide was coming in. Tried the sled but could not control the direction because of the 20 km/h side wind. During the removal of the sled some spots of fuel were noticed on the ice. Returned to base as a precaution.

Filled up with fuel and measured the depth in both tanks as 36 cm.

Thursday, March 5th

No fuel spots in the snow under the craft, and the fuel level had not changed indicating that there was no leak in the tanks and the fuel spots previously noticed may have been due to some diesel remaining on the deck after filling.

Attached the sled by a rope between the rear lifing eyes and a pulley on the front of the sled. The rudders could now impose a yawing moment on the craft without being restricted by the drag of the sled and one long groove along the channel and one across the channel were made. A piece of flat ice was found and a circle of .5 km cut.

The tide had caused a heavily rafted section in the middle of the previously flat ice in the middle of the channel. The height of the disturbance was greater than the clearance of the craft and there was considerable impact between the bottom of the craft and the ice. Debris indicates much of the wooden skids have been torn off.

Broke about 300 m x 200 m in 1 hour for an ice thickness of 35 cm. However, much of the time was spent in avoiding the highest of the ice pinnacles.

Friday, March 6th

Winds above limits. Carried out routine maintenance.

Saturday, March 7th

Went to the open water and started to break ice. The hydraulic oil temperature was a little hot at 180°F, but well below the limit of 250°F. It was decided to reduce the temperature by bringing the craft off cushion and immersing the hydraulic lines in the cold river water. During the next five minutes the hydraulic system was run at 500 psi, to circulate the fluid, and the engine set at 1,700 rpm to keep the craft on station, close to the ice edge.

When the throttle was opened there was no response and the engine died a half minute later.

The current was rapidly taking the craft down the center of the channel towards the jam at S 32 and after all the quick fixes had failed to restart the engine it was decided to launch the dinghy, tow the craft out of the channel, and anchor it in the shallows where repairs, or salvage, could be carried out without interfering with shipping. The craft was finally anchored at the position indicated on Fig 2, and the crew rowed ashore through broken ice and a thin ice sheet.

An attempt was made to return to the craft when the tide turned but it was getting dark and the craft appeared to be safe and floating level in open water.

Sunday, March 8th

Observed the 140 from the shore. Vessel riding level but in the center of a newly formed ice sheet, too

thin to walk on but too thick to row a boat.

Monday, March 9th

Attempted to reach the craft by two crew walking either side of the dinghy. The ice proved too thin and the machine was inspected from the Coast Guard helicopter. It was locked in the ice sheet, slightly down by the stern, but did not seem to be in any danger of sinking.

Tuesday, March 10th

Reached the craft and the C.A.F. dropped two drums and a hand pump to pump out the fuel tanks and lighten the vessel. One hundred litres was taken from the port tank but the left tank was filled with 6 cm of fuel over water that had turned to ice at the water line. The liquid water underneath could not be pumped out since it turned to ice in the metal pump and jammed it.

The ice level in the engine bay was not above the starter and thus the engine could be started once the problem had been resolved.

The craft was surrounded by a 12 cm ice sheet which may stop the entry of any further water and keep the craft buoyant.

Wednesday, March 11th

The overnight temperature had dropped to -26°C which had covered all of the previous open water with ice.

The propeller was very difficult to move which was attributed to the cold and some heating must be available before the engine could be started.

The problem was discussed with Caterpillar who did not think there was much chance of ice in the injector system, but the delivery pipes must be purged, again requiring a heat source.

Thursday, March 12th

Went to craft. C.A.F. dropped generator set. Broke the ice in the fuel transfer compartment, found L.H.S. tank lock shut off. Propeller still too stiff to turn. Would not ease when warm. Returned to shore. Trevor fell through ice.

Friday, March 13th

There had been several incidences where the crew travelling to the craft had partially fallen through the ice while grasping the side of the dinghy. As a precaution the immersion suits were changed to dry suits.

C.A.F. dropped a generator set which was connected to the battery charger and the block heater in an attempt to start the engine. The propeller was still extremely stiff to turn, more than during the cold weather at the beginning of the program, suggesting that either the engine or the hydraulic pump had seized.

In the afternoon the craft was cut out of the ice with a chain saw and a C.A.F. Chinook helicopter lifted it to Grande Anse.

The weight on the sling was reported to be close to 11,000 kg, some of which must have been due to the downwash from the rotors.

A quick inspection of the craft at Grande Anse showed that the craft was in good shape with no apparent damage to the skirts. There was no noticable holes in the structure through which water could enter the fuel tanks.

Saturday, March 14th

Carried out a closer inspection at Grande Anse. Still no sign of any hole in the structure.

The propeller is virtually impossible to turn confirming that either the engine or hydraulic pump has seized. Made a jig to remove the hydraulic pump, removed the cover but did not find any evidence of a failure. Removed the cover on the engine fuel control unit and found it full of ice. This was assumed to be the cause of the problem.

Sunday, March 15th

Removed the radiator and intercooler to expose the top of the engine and the fuel control unit.

Removed fan cross shaft as part of the maintenance schedule, inspected the bearings and coupling which all appeared to be in good shape. A small sleeve had come loose which would not pose a mechanical hazzard, but would sound like a bearing failing. It will be rewelded before the shaft is replaced.

Monday, March 16th

Caterpillar inspected the engine and found the pump full of ice. Decided to install a reconditioned unit with a 6 month warranty to save some time.

Tuesday, March 17th

Installed a new fuel unit and repaired cross shaft.

Wednesday, March 18th

Repairs complete. Renewed a leaky gasket on the cover of the hydraulic pump.

Thursday, March 19th

Decided to bring the craft back to Chicoutimi by road rather than drive it up over rough ice. The bottom of the craft was covered in a 6 cm layer of ice and it took 1½ hours to clear the bottom pins so that they could be removed and the sponsons raised.

The center apron had been destroyed, probably when it was lifted from the ice.

The craft was taken to a warm area where it could thaw out.

Friday, March 20th

Vehicle put back on the ice and two 45 gallon drums secured in the cabin to replace the main fuel tanks and avoid any suggestion of fuel contamination through leaks in the hull. Two reserve barrels were left on the ice so that the operation could continue through the weekend when there was no fuel delivery.

Saturday, March 21st

Went to S 52 and repeated the previous ice thickness measurements. The cold spell of the preceding weeks had increased the thickness at S 52 from 45 to 64 cm and that at S 47 had gone from 36 to 54 cm. The water is now 200 m downstream of S 45. In three hours the ice had been broken to a point half way between S 45 and S 47. A distance of 1.5 km.

The operation was terminated when an "O" ring on the hydraulic pump failed. A temporary repair enabled the craft to return to base.

The ambient temperature was +8°C resulting in the ice being very soft and like rubber.

Sunday, March 22nd

Unable to get a spare "O" ring on the weekend. Repaired six skirt segments and three lanyards.

Monday, March 23rd

The warm temperatures have made the underside of the

ice very uneven and the thickness ranged from 25 cm to 50 inches. However, it thickened to a constant 55 cm towards S 52. It took 3.5 hours to break to a point 100 m from S 52 in the channel. A distance of 2.5 km.

Tuesday, March 24th

Started to clear the 55 cm thick ice in front of the pier between the channel and the pressure ridge. After ½ hour the coupling to the radiator fan became disengaged resulting in the coolant overheating. It was temporarily secured in place with a hose clamp. Almost immediately afterwards the lift fan cross shaft walked in the bearings. The position of the pulleys and locking devices were checked and tightened and no further problems were encountered in this area.

Towards the end of the afternoon the oil seal on the shaft of the hydraulic motor leaked intermitantly and the fix to the coupling failed causing the loss of a substantial part of the coolant. It was getting dark and rather than return to Chicoutimi in steps during which the craft was stopped to cool the engine, it was decided to leave the craft 3 km upstream at the Irving Fuel Farm.

Wednesday, March 25th

The ice to the north of the pressure ridge had thinned due to the warm temperature of the previous day and

was measured at 38 cm. It broke easily up to the pressure ridge which by now had reduced in height from 1 m to 75 cm high.

The thickness on the other side of the ridge had a minimum value of 60 cm, with patches up to 70 cm, the whole area being covered by 13 cm of slush. Seven attempts were made to break ice before cracks appeared after which pieces 30 m by 40 m were dislodged at each pass. The presence of the pier and the two dolphins made navigation diffcult.

The craft got hung up on the pressure ridge when ice jammed up under the floor between the structural beams.

The operation was stopped for the day when the core of one of the rudder control cables burst through the casing. Because of the rafted surface appearing on the river at Chicoutimi it was decided to leave the craft at the pier.

Thursday, March 26th

The control cable was repaired by a temporary sheath and the remainder of the ice broken from in front of the pier. Ports Canada advised that the ice breaking program was complete so the craft was then driven to Grande Anse to be lifted out.

Friday, March 27th

Craft inspected at Grande Anse. Some damage to the bottom will require repair before recertification.

Saturday, March 28th

Started to instal sled on the bow. Started to repair drag skirt.

Sunday, March 29th

Continued to install sled and repair drag skirt.

Monday, March 30th

Completed repairs. No ice on river. Difficult to move craft to another location due to half load restrictions.

Tuesday, March 31st

Checked craft statically with sled installed. Stability good. Trucked vehicle back to Chicoutimi.

Wednesday, April 1st

Closed down project.

Call No. – Cote N° CA1 DTC 800 87 P62
No. 21958
Vol.
Copy Copie 2
Due Date – Date de retour
Library and [illegible] Centre de documentation (DLA)
RECEIVED - REÇU LE
FEB 22 1988
Transport Canada / Transports Canada
JUL 15 1988